Emotion Regulation and Decision Making:

How Rumination Affects Decision Making and Risk Taking Behaviors

Honors Research Thesis

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By

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Abstract

Rumination is an emotion regulation strategy consisting of repetitive thinking about things that have happened in the past. Excessive use of rumination has been linked to different kinds of behavioral dysregulation such as binge eating, binge drinking (Nolen-Hoeksema et al., 2008) and non-suicidal self-injury (Selby & Joiner, 2009). Selby argues that these risky and impulsive behaviors serve as a mechanism to try and distract oneself from the escalating spiral of negative affect elicited by rumination (2009). The present study tests this model by investigating how trait level rumination is associated with engagement in risky decisions in order to avoid a ruminative task. To investigate this, we designed a modified probability discounting task that asks participants to make choices and take risks about a hypothetical rumination task. For our analysis, we used methods described by Reed et al. (2012) to find the K estimate and the Area Under the Curve (AUC), both of which measure one's decision making curve. Our results showed no relationship between rumination and choices on the probability discounting task for either the K estimate (p = .581) or the AUC (p =.362). Future research should improve upon this task by using and adaptive discounting framework and work towards a better understanding of the pervasive cycle of chronic rumination.

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Introduction

Rumination is excessive and repetitive thinking about things that have happened in the past (e.g., regrets, mistakes; Nolen-Hoeksema, Wisco & Lyubomirsky, 2008). Most people ruminate at some point in their lives, but chronic rumination is associated with many different types of psychopathology, such as depression, anxiety, eating disorders, and substance abuse (see Aldao, Nolen-Hoeksema, & Schweizer for a meta-analysis). Rumination is also associated with many other negative outcomes such as reduced motivation, reduced social support, and increased negative affect which can in turn fuel psychopathology (Nolen-Hoeksema et al., 2008).

One of the main effects of rumination is an increase in negative affect. Not only does rumination increase negative thinking about the past, it also affects the way that people think about the present and future (Nolen-Hoeksema et al,. 2008). A study by Lyubomirsky, Caldwell and Nolen-Hoesksema (1998) found that dysphoric participants, or participants who scored higher on a scale of depression, who were told to ruminate retrieved more negative memories and were more likely to recall negative events from their past as happening more frequently than participants told to use other emotion regulation strategies. Dysphoric participants told to ruminate were also more likely to attribute any negative current events to their own personal failures and tended to be more self-critical (Lyubomirsky, Tucker, Caldwell & Berg, 1999). Furthermore, when thinking about the future, participants told to ruminate were more

pessimistic and had lower expectations for positive events compared to participants told to use distraction. (Lyubomirsky & Nolen-Hoeksema, 1995).

Rumination is a very negative experience, but people ruminate anyway because they believe that obsessively thinking about the past will help them solve their problems (Nolen-Hoeksema et. al., 2008). Contrary to what many believe, rumination hinders effective problem-solving because instead of developing possible solutions people become overly fixated on their problems without taking any action towards a solution (Nolen-Hoeksema et al., 2008). Lubomisrky, Tucker, Caldwell, and Berg (1999) found that dysphoric participants prone to rumination viewed their problems as more severe and more difficult to solve. Dysphoric ruminators felt more overwhelmed, were overly self-critical, blamed themselves for all their problems and felt less control over their life (Lyubomirsky et al., 1999). Not only did dysphoric participants view their problems as more intense, but they also reported that even if they knew of a way to solve their problems they were not likely to implement any solutions (Lyubomirsky et al., 1999). Rumination is also highly associated with overall negative well-being (Harrington & Loffredo, 2011). These negative effects of rumination are not enough to stop people from ruminating because many people hold positive meta-cognitive beliefs about rumination; this means that they believe that rumination is a positive thing. People believe that by ruminating they are gaining a better understanding and awareness of their problems and true emotions. These positive thoughts about rumination contribute to one's tendency towards rumination (Watkins & Moulds, 2005). A study by Papageorgiou and Wells (2001), found that depressed participants reported more positive views of rumination than non-depressed participants and reported using them as a coping strategy for their depression. This study also found that

participants reported engaging with rumination due to these positive beliefs, but once they realized that rumination does not make them feel better, they started viewing rumination as negative. (Papageorgiou & Wells, 2001). Negative beliefs about rumination induce feelings of helplessness and lack of control over one's life (Papageorgiou & Wells 2001**).** The helplessness that comes with these negative beliefs about rumination perpetuates the ruminative cycle because if people do not feel as though they have control over their own thoughts, they will be unable to stop ruminating (Papageorgiou & Wells 2001). Another study by Papageorgiou and Wells (2003) found that these negative beliefs about rumination can lead to increased symptoms of depression. This would also perpetuate the ruminative cycle, because people would then ruminate on their depressed mood. This interaction between positive and negative beliefs about rumination may contribute to the maintenance of depression (Papageorgiou & Wells, 2001; Papageorgiou & Wells, 2003).

Along with affective dysregulation, rumination often leads to behavioral dysregulation (Selby, Anestis, & Joiner, 2008; Nolen-Hoeksema, et al., 2008). The Emotional Cascade Model argues that risky and impulsive behaviors serve as a mechanism to distract oneself from the escalating spiral of negative affect elicited by rumination (Selby & Joiner, 2009). According to the model, people engaging in higher levels of rumination may use impulsive behaviors such as binge eating, binge drinking (Nolen-Hoeksema et al., 2008), and non-suicidal self-injury (Selby & Joiner, 2009) in order to escape their negative self-reflective thoughts. Selby, Kranzler, Panza and Fehling (2016) also argue that people engage in these impulsive behaviors because other forms of distraction, such as talking to a friend or taking a shower, are not potent enough to effectively disrupt the cycle of rumination. The Emotional Cascade Model argues that

individuals with a propensity to ruminate are willing to take behavioral risks to escape rumination. A recent study by Selby et al. (2016) found that higher levels of rumination and negative affect significantly predicted impulsive behaviors. Rumination and negative affect were associated with an increase in each other along with an increase in impulsive behaviors (Selby et al., 2016). This provides some evidence for the Emotional Cascade Model and shows that among people who reported engaging in more impulsive behaviors, rumination and negative affect synergistically build upon each other until people fell that they need to engage in impulsive behaviors to escape the cycle (Selby et al., 2016). Unfortunately, engaging in these impulsive behaviors can lead to more negative affect and rumination which simply perpetuates the cycle (Selby et al., 2008). Even though these risks are taken in an attempt to avoid a negative ruminative experience, they can lead to a decreased quality of life, difficulty with relationships and impairment in everyday functioning (Selby et al., 2008). Understanding rumination's relationship with risk-taking has important implications for developing new strategies to inhibit these self-destructive risky behaviors**.** The present research will help to inform our understanding of why rumination-prone people tend to make risky decisions and engage in risky behaviors. This research project will help to test the Emotional Cascade Model and expand this literature by investigating how trait level rumination is associated with engagement in risky decisions in order to avoid a ruminative task.

To investigate these risky behaviors that people use to escape rumination, we designed a modified probability discounting task. Probability discounting is defined as the decrease in the subjective value of a reward as the likelihood of receiving that reward also decreases (McKercher & Renda, 2012). That is, when the probability of receiving a larger reward decreases

people will be more likely to choose a smaller, but certain reward. Classic probability discounting uses monetary rewards; for example, imagine you were given the option to choose between a 10% chance of winning $10 versus 100% chance of winning $3. You might select the $3 for certain option because you would take a risk of winning nothing if you selected the 10% chance of winning $10. On the other hand, you may select the 10% chance option because you believe that even though you have a 90% chance of winning nothing, the 10% chance that you win $10 is worth it. As the size of the reward increases, taking a risk of walking away with nothing may become a more acceptable risk. For example, if you were choosing between $3 for certain versus a 10% chance of winning $100 you might be more inclined to take the risk because the reward is much higher. Each individual's subjective value of the reward is crucial in probability discounting; some people tend to be very impulsive and risky when making these decisions whereas other people tend to be more conservative (see figure 1). Because the subjective value of the reward carries significant influence on one's decision making, there are individual differences in probability discounting curves. For example, smokers (Reynolds et al., 2004) and college aged gamblers (Holt, Green, & Myerson, 2003) have been shown to be more likely to take risks on probability discounting tasks.

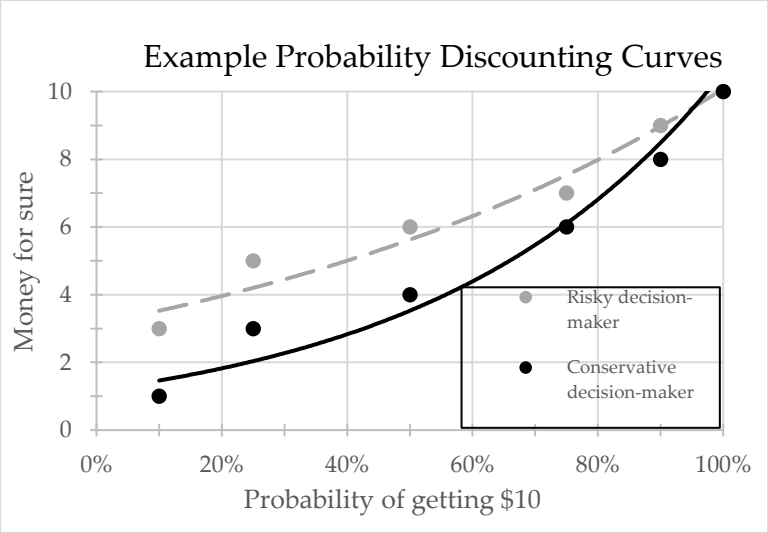

Figure 1. Example individual differences in probability discounting curves. The more cautious individual has a steeper decision making curve compared to the risky individual because they wait longer until they choose the risk option.

In probability discounting tasks, participants are asked a series of questions similar to the above example. These questions involve choosing between two options: the uncertain option which ranges range from of a 0% to 100% likelihood of receiving a larger reward and the certain option which is a 100% likelihood of receiving a smaller reward. Originally, behavioral economists used probability discounting to help explain consumers' financial, spending, and saving behaviors (Thaler & Benartzi, 2004). Although originally studied from an economic perspective by using monetary rewards (e.g., "would you rather have a 100% chance of receiving $3 or a 50% chance of receiving $10"), probability discounting can also be used to help explain many other behaviors using non-monetary rewards such as drugs, tangible objects, and social interaction (Charelton, Fantigo & Gossett, 2012). Most of the literature on discounting has focused on approach motivation (e.g. money), but little work has examined avoidance motivation.

The present study assesses willingness to take risks to avoid an unpleasant experience, specifically, by asking participants to make decisions about the risk of engaging in a rumination task. Similar to classic probability discounting, participants choose between a certain option where they complete a rumination task for sure or the uncertain option where they take a risk in the hopes of avoiding the rumination task. The drawback of the risky option is that if the participant does not succeed they would have to complete the rumination task for a longer duration than if they had selected the certain option. The participant must decide if the benefit of getting out of the rumination task altogether is worth the risk of doing the task for a longer time than if they chose the certain option. This method provides us the opportunity to learn more about how much risk people are willing to take to avoid unpleasant ruminative

experiences. By using a rumination task rather than a monetary task, this project will extend the literature to examine how people choose between aversive experiences. This research could have important implications for developing a more cohesive understanding of rumination and how people choose to engage with it.

Hypothesis

I hypothesize that people higher in trait rumination will find the rumination task more aversive, and therefore will be more likely to take greater risks on the discounting task to allow for an opportunity to avoid rumination. I also hypothesize that participants who report higher state level of rumination will also take greater risks on the discounting task.

Methods

I conducted this research by analyzing data collected as a part of a larger study in the Psychology and Affective Sciences lab. We recruited undergraduate participants for the study using the Research Participation Program (REP), oversampling for participants who self-reported high levels of rumination. We recruited 265 participants but some were excluded due to missing data or failure to follow directions (N=13) and other participants were excluded for inconsistencies (N=44) in decision making which left a final sample of 208 participants. The final sample had 115 female participants (55.3%), 174 Caucasian participants (83.7%), and an average age of 19.23 (SD = 1.88; range 18-31). Participants completed baseline questionnaires that measured demographics, trait, and state level rumination. The state rumination measure was taken from the baseline questionnaires and asked participants to report the maximum amount of rumination that they felt that day. Participants then, completed a modified probability

discounting task that allowed us to examine their decision making and the likelihood of risk-taking to avoid rumination.

Trait Rumination Measure

Ruminative Response Scale—Brooding Scale (RRS-B). This scale measures how often one uses rumination and engages in ruminative behavior when stressed (Treynor, Gonzalez, & Nolen-Hoeksema, 2003). Each item is ranked on a scale of one to four depending on how often one engages in these thoughts. The brooding subscale was taken from the original 22 item scale, and all items overlapping with depressive symptoms were removed. This five-item subscale contains items such as "what am I doing to deserve this" and "why do I have problems other people don't have" (Treynor et al., 2003). This measure has good internal consistency (α = .77) and is widely used to study rumination (Treynor et al., 2003). The participants average a score of 11.96 (*SD* = 3.48) on the scale. One participant (.5%) scored the minimum of 5, and 4 participants (1.9%) scored the maximum of 20.

Modified Probability Discounting Task

Participants completed 66 decision trials (See Appendix A) in a computerized decision-making task presented using MediaLab. Each trial involved making a decision about a hypothetical rumination task. Deception was involved in this study because participants were told that their decisions would impact tasks that they would complete later in the study. In this hypothetical task, participants were told that they were going to have to think about things they regret, mistakes they have made, and things they wish they could do over. This task was designed to mimic the process of rumination because rumination involves dwelling on the past and on things one wishes they could do over. After explaining this regrets and mistakes task,

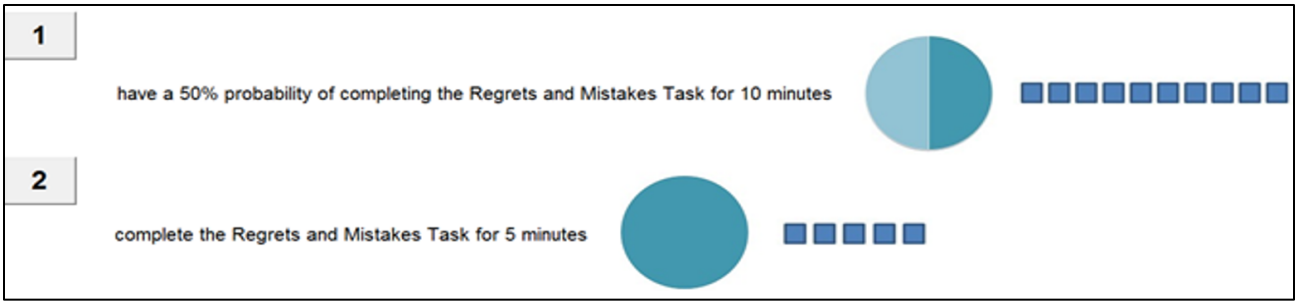

Figure 2. Example decision-making trial. Participants would need to decide if the 50% risk of completing the task for 10 minutes is worth the benefit of avoiding the task completely.

the participants were asked to re-explain the task in their own words to make sure they completely understood. The research assistants would then clarify if there was any confusion. After this, participants completed the decision-making trials, each of which involved choosing between a certain option and an uncertain option. The uncertain option involved a probability (ranging from 0-100%) of completing the rumination task for 10 minutes. The certain option involved completing the rumination task for sure for a shorter or equal duration (ranging from zero to ten minutes). For example, participants were asked to choose between completing the task for five minutes for sure, or having a 50% chance of completing the task for ten minutes. Pictures depicting the probability of the task as well as boxes representing the duration of the task were also included as a visual representation in each trial (See figure 2). This decision is also made in the context of knowing that the alternative would only last for five minutes. As the probability of completing the uncertain option increases, it becomes decreasingly beneficial to choose it over the certain option. On the other hand, as the duration of the certain option increases it may be increasingly beneficial to take the risk and choose the uncertain option. The point at which the participant switches from choosing the uncertain, or probability, option to the sure option This is the point where the potential of escaping the rumination task altogether is not likely enough to risk completing the task for 10 minutes. Each participant will have six

25% chance completing task for 10 minutes	
Minutes for Sure	Choice
10	P
9	P
8	P
7	P
6	P
5	C
4	C
3	C
2	C
1	C
0	C
P= probability option C= Certain option	

Figure 3. Example decision making for 25% probability. An indifference point is a switch from the probability to a certain option. In this example the indifference point for 25% probability is 5.

indifference points, one for each of the probabilities used in this study (10%, 25%, 50%, 75%, 90% and 100%). Figure three shows an example decision-making pattern for the 25% chance trials. In this example the participant switched from the probability option to the certain option at the 5-minute mark, so their indifference point for 25% would be 5.

Results

To analyze these data, we found each participant's indifference points. Due to the possibility that a participant could press one wrong button and it could drastically affect their decision-making curve, the highest and lowest indifference points, which in most cases were the same, were averaged together to find a more accurate representation of their true indifference point. On the 25% chance options, the participant represented in Figure 4 switched from choosing the probability option to the certain option at the two-minute mark but switched back to the probability option at three minutes. They then switched from the probability to the certain option again at six minutes. It is possible that they clicked the wrong key when they chose to switch at two minutes or the mistake could have been later when they switched at six minutes. Most participants (N=144) had at least one discrepancy between their highest and lowest indifference points. These discrepancies affected the discounting curves, so because we do not know where the mistake was made, choosing to use either the highest or lowest indifference point could introduce further error. Due to this we

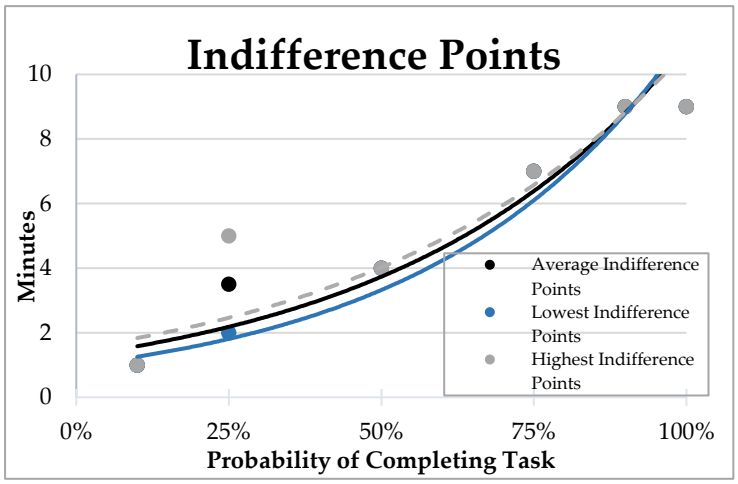

Figure 4. Represents participant with discrepant highest and lowest indifference points for 25% chance option.

averaged the highest and lowest indifference points to minimize error. We then entered the indifference points into Microsoft word and used Microsoft excel solver to find the K estimate and the Area Under the Curve (AUC) using methods described by Reed, Kaplan, and Brewer (2012) for each participant. The K estimate is a best-fit curve of decision making that minimizes the residuals and the AUC is another measure of discounting that is atheretical because it directly calculates the area under the data points rather than calculating a best fit line curve (Reed et al., 2012). We then used SPSS version 24 to test the correlations. We did not find any significant correlations of gender with trait rumination (r =.075, p =.281) state rumination (r =-.042, p =.547), K estimate (r =.075, p = .280) or AUC (r =-.031, p =.653).

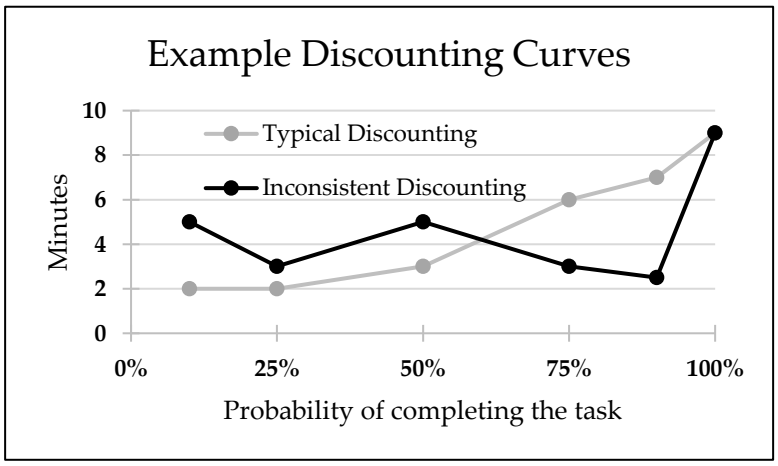

Figure 5. Example of two participants' discounting curves. One curve is representative of typical decision-making and one is representative of inconsistent decision making

Exclusions

Out of the original sample of 265, 13 participants were excluded for missing data or failure to follow instructions. 44 participants were excluded for inconsistencies in decision-making and two participants were excluded

because they fit into both categories. Discounting is a switch from choosing the probability option to choosing the certain option. The criteria for exclusion based on inconsistent decision making was if a participant switched in the wrong direction, that is from the certain option to the probability option, by two or more minutes. For example, figure 5 compares what we would consider typical discounting and what we would consider inconsistent discounting. This participant chose to switch from the probability option to the certain option at 5 minutes when it was a 50% chance of completing the task. They then backtracked and when it was a 75% chance of completing the task they switched at 3 minutes. This pattern is inconsistent with logical decision making, so participants with decision-making patterns such as this were excluded from the analyses because it is possible that they were not paying as much attention to the task.

Internal Consistency

Using methods described by Hurst, Kepley, Mccalla & Livermore (2011) we calculated the internal consistency of the probability discounting task. The indifference points at each probability were positivity correlated with each other with a p value of .004 or less (See Table 1). We then calculated Cronbach's alpha and found the task to have good internal consistency (α = .799).

Rumination and Discounting

We did not find significant relationships between the trait level rumination, as assessed by RRS—B, and either the K estimate (r = .075, p =.261) or the AUC (r = -.018, p = .793). We also did not find a significant relationship between state-level rumination and either the K estimate (r =-.037, p =.592) or the AUC (r = .011, p = .872).

Table 1
Reliability Correlations

		Discounting 10%	Discounting 25%	Discounting 50%	Discounting 75%	Discounting 90%	Discounting 100%
Discounting 10%	Pearson Correlation	1					
	Sig. (2-tailed)						
	N	205					
Discounting 25%	Pearson Correlation	.650**	1				
	Sig. (2-tailed)	.000					
	N	205	207				
Discounting 50%	Pearson Correlation	.490**	.596**	1			
	Sig. (2-tailed)	.000	.000				
	N	205	207	207			
Discounting 75%	Pearson Correlation	.401**	.478**	.604**	1		
	Sig. (2-tailed)	.000	.000	.000			
	N	205	207	207	208		
Discounting 90%	Pearson Correlation	.351**	.333**	.485**	.624**	1	
	Sig. (2-tailed)	.000	.000	.000	.000		
	N	205	207	207	207	207	
Discounting 100%	Pearson Correlation	.164*	-.004	.219**	.197**	.227**	1
	Sig. (2-tailed)	.019	.956	.002	.004	.001	
	N	205	207	207	208	207	208

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 1. Reliability Correlations. The correlations between the indifference points for each of the probabilities.

Discussion and Future Directions

This study did not find a relationship between trait level rumination and responses of the probability discounting task. The present study had some limitations, some of which could help to explain the null results. One limitation is how we measured rumination. We used the RRS—Brooding scale as our measure of trait rumination. This scale was intended to capture what people do when they are feeling sad as well as capture a wide range of thoughts including self-criticism as well as criticisms of others (Treynor et al., 2003). In our sample, only one participant scored minimum and four participants scored the maximum score. It is possible that we did not have enough variability. Even though this scale was intended to capture a wide arrange or ruminative thoughts, it is only 5 items so it is possible that it did not quite capture the full spectrum of trait level rumination. There is also an issue of state versus trait rumination. It is possible that people will act differently and make different decisions when they are actively ruminating rather than just thinking about the possibility of rumination. We did have participants report state level rumination, but the measure we used was not a true measure of state rumination. One issue with that measurement was that it was not administered directly before the discounting task, instead it was administered as part of the baseline questionnaire. Also, the state measure asked participants to rate the maximum level of rumination they experienced that day rather than asking them to measure how ruminative they were feeling directly in the moment. Future research should measure true state rumination and secondly, add a mood or rumination induction. Perhaps by inducing a negative or ruminative mood we can measure how people will make decisions when they are actively engaged in rumination.

This was a novel discounting task so it is possible that the task itself did not measure rumination discounting in the way it was intended to. When looking at the data there were many participants that made choices that were not consistent with logical decision making. As explained above in figure 3 some participants had a pattern of decision making that is inconsistent because logically people would tend to switch to the certain option earlier as the likelihood of completing the task increases. When these logical inconsistencies are present in participant responses, it is difficult to know the participant's true indifference points. One way to improve this task would be to use an adaptive assessment of discounting. In an adaptive discounting task, if a participant responds in an inconsistent way they would be asked follow-up questions to clarify their responses. This would also allow us to get a more exact indifference for participants. Instead of grouping all participants who had an indifference point of 5 together, we would be able to differentiate between participants who had an indifference point of 5.1 from participants who had an indifference point of 5.4. Overall, an adaptive discounting task could help minimize human error and could also help us to gain more precision in our measurement.

In this task, we also had no way of identifying participants who were responding at random. Some of our other exclusions may have accounted for some of these participants, but we can still not be sure that participants were actively participating in the task. A study by Hauser and Schwarz (2016) found that only 39% of an undergraduate subject pool fully read experiment instructions when presented with them on a computer screen. Additionally, a study by DeRight and Jorgensen (2015) found that 10% of undergraduate students showed insufficient effort and poor performance. This is important for our study because our sample was made up

of undergraduate participants and we had no way of assessing effort. One way to combat this issue would be to include attention questions or other measures of effort. By measuring participant attention and effort we could exclude any participants who are responding at random and reduce overall error.

Even though this study did not find a significant relationship between rumination and risk-taking behavior there are many ways that it can be improved and studied further. It is important to continue this line of research because understanding this relationship can help lead to a better understanding of the phenomenon of rumination and how it affects our daily lives. Chronic rumination affects many people and is a pervasive cycle that is very difficult to break; understanding how willingness to take risks and decision making are influenced by rumination can lead to the development of new ways to break the cycle. These interventions could help many people to stop going down the negative path of ruminative thought and instead use healthier strategies to regulate their emotions.

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Appendix A

Rumination Discounting

Question to Participants:

Would you rather complete the Regrets and Mistakes Task for X-minutes or have an X probability of completing the Regrets and Mistakes Task for 10-minutes?

Trial #	Duration of certain rumination task	Probability of longer rumination task
1	0	10%
2	0	25%
3	0	50%
4	0	75%
5	0	90%
6	0	100%
7	1	10%
8	1	25%
9	1	50%
10	1	75%
11	1	90%
12	1	100%
13	2	10%
14	2	25%
15	2	50%
16	2	75%
17	2	90%
18	2	100%
19	3	10%
20	3	25%
21	3	50%
22	3	75%
23	3	90%
24	3	100%
25	4	10%
26	4	25%
27	4	50%
28	4	75%

29	4	90%
30	4	100%
31	5	10%
32	5	25%
33	5	50%
34	5	75%
35	5	90%
36	5	100%
37	6	10%
38	6	25%
39	6	50%
40	6	75%
41	6	90%
42	6	100%
43	7	10%
44	7	25%
45	7	50%
46	7	75%
47	7	90%
48	7	100%
49	8	10%
50	8	25%
51	8	50%
52	8	75%
53	8	90%
54	8	100%
55	9	10%
56	9	25%
57	9	50%
58	9	75%
59	9	90%
60	9	100%
61	10	10%
62	10	25%
63	10	50%
64	10	75%
65	10	90%
66	10	100%